Dynamics Second

[redacted]

جامعة فلسطين التقنية



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السلطة الوطنية الفلسطينية



وزارة التربية والتعليم العالي

Palestinian National Authority

Ministry of Education & Higher Education

Section A: Answer <u>both</u> questions in this section

امتحان للاطلاع على الأسئلة فقط

QA1

An automobile having mass M= 2000 kg travels up a slope ($\theta = 7°$) at constant speed v = 100 km/hr. If mechanical friction and wind resistance are neglected, determine the power developed by the engine (P_{eng}) if the automobile has efficiency $\varepsilon = 0.65$.



Choose one of the following answers: **[5 marks]**

a) P_{eng} = 122.5 W
b) P_{eng} = 202.5kW
c) P_{eng} = 108.6 kW
d) P_{eng} = 102.2 kW
e) None of the above

5/5

هذا الامتحان ليس لعن!!

Solution: **[10 marks]**

P= Fv

~~F= Mg Cos7 = 2000 * 9.81 * Cos7~~
~~= 19620 * Cos7 = 2391~~ 2391

~~P= Fv = 2391*100 = 239100~~

F_{eng} = Mg Sin7 = ~~19620~~ = 2391 N

~~P = F v = 19620*100 = 2391*100 = 239100~~

v = 100000 / (60x60) = 27.7 M/S ? How?

Feng = 19620 so ?

5/10

تم الرفع بواسطة م. معن ابو عيسى

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QA2

Each of the two elastic rubber bands of the slingshot has an un-stretched length ℓ = 200 mm. If they are pulled back to the position shown and released from rest, determine

a) the speed of the pellet of mass M = 25 g just after the rubber bands become un-stretched. Neglect the mass of the rubber bands.

b) the maximum height the pellet of mass M = 25 will reach if it is fired vertically upward. The band has a stiffness k = 50 N/m

Given:

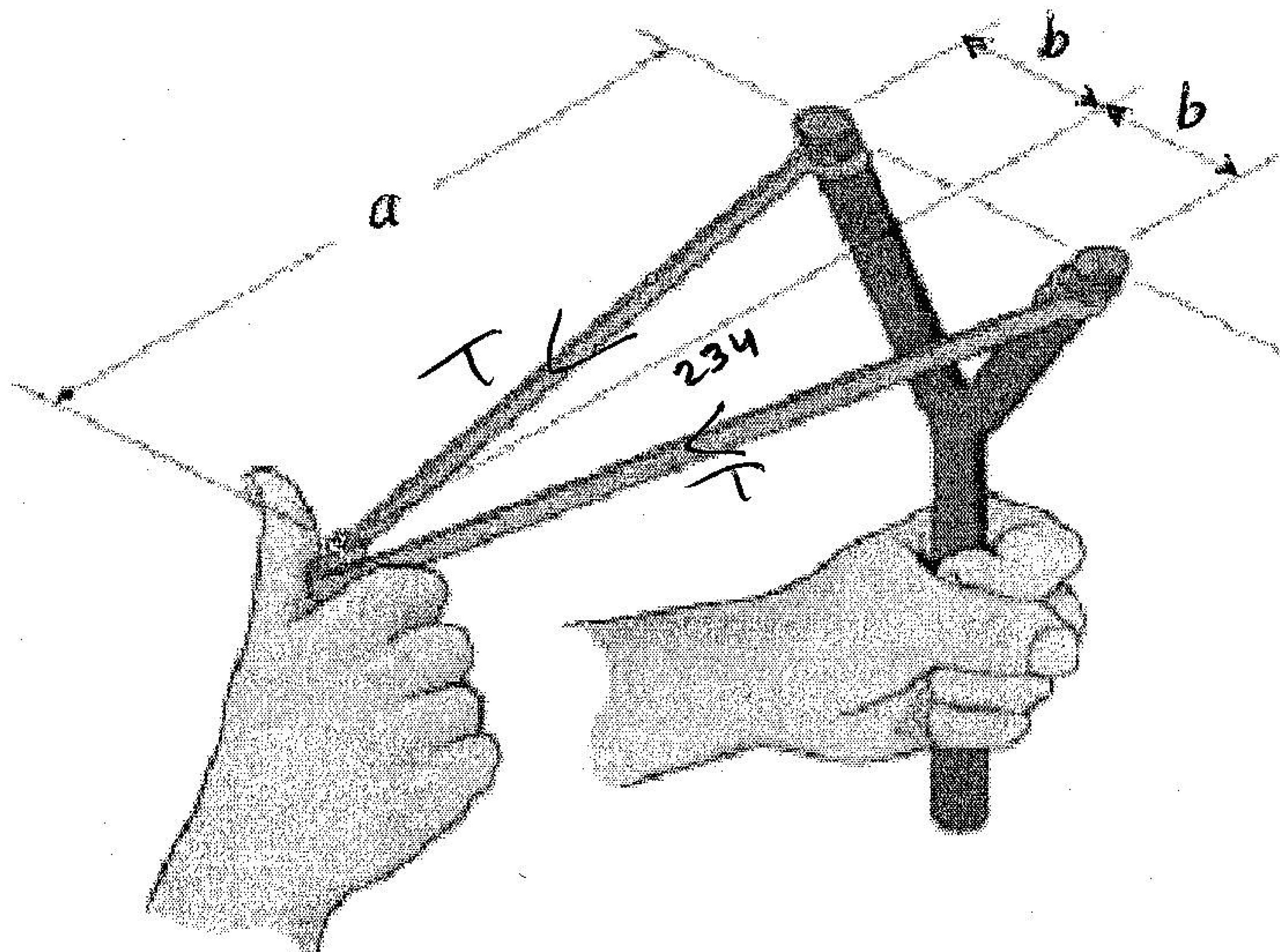
l = 200 mm

M = 25 gm

a = 240 mm

b = 50 mm

$k = 50 \frac{N}{m}$



Choose one of the following answers: **[5 marks]**

a) v = 2.86 m/s, h = 416 mm

b) v = 2.86 m/s, h = 416 mm

c) v = 2.86 m/s, h = 416 mm

d) v = 2.86 m/s, h = 416 mm

e) None of the above

5/5

Solution: **[10 marks]**

$M_1 v_1 + \Sigma F \Delta t = M_2 v_2$

$F = 2T$

8/10

Section B – Answer Any 2 questions ONLY

QB1

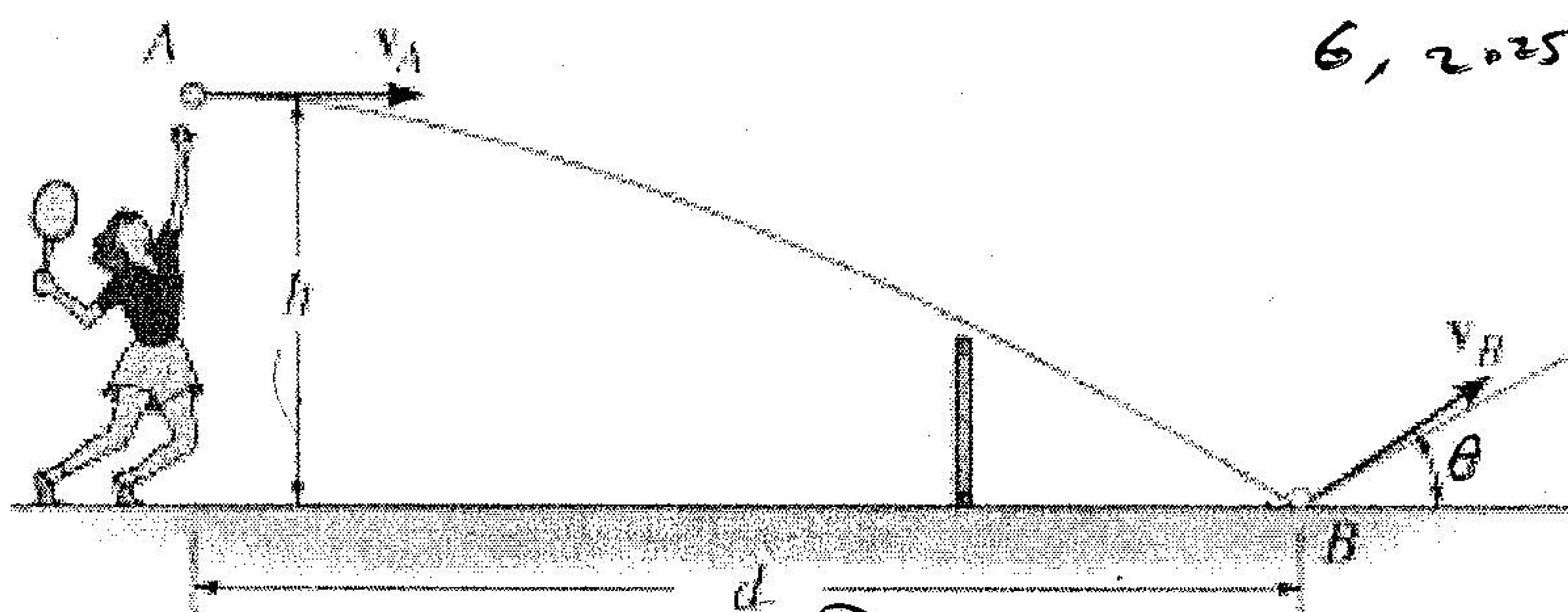
It was observed that a tennis ball when served horizontally a distance h = 2.25 m above the ground strikes the smooth ground at B a distance d = 6 m away. Taking the coefficient of restitution e = 0.7, determine

a) the initial velocity v_A of the ball **[8 marks]**

b) the velocity v_B of the ball just after it rebound from the court at B. **[8 marks]**

c) the angle (θ) of the ball trajectory just after it strikes the court at B. **[4 marks]**

6, 2.025 6.408



Solution

How?

(a) $\sqrt{A} = \sqrt{2gh} = \sqrt{2*9.81*2.25} = 6.6\ M/S$ Cos 20.5 = 6.18 M/S

?

(b) $M_1 v_1 + M_2 v_2 = M_1 v_1 + M_2 v_2$ What is this ?

$M_1 v_1 = M_1 v_1'$

~~$v_B = v_A \cos\theta$~~

$\left(\frac{v_1'}{v_1}\right) = 0.7$

~~4.62 = 6.6 cos θ ⇒ cos θ~~

6.18 × 0.7 ⇒ v_1' ⇒ $v_1' = 4.32$ m/s

(c) $v_B = v_A \cos\theta$

$4.62 = 6.18 \cos\theta$

$\Rightarrow \cos\theta = \frac{4.62}{6.18} = 0.7 \Rightarrow \theta = \cos^{-1} 0.7 = 45.6°$ X

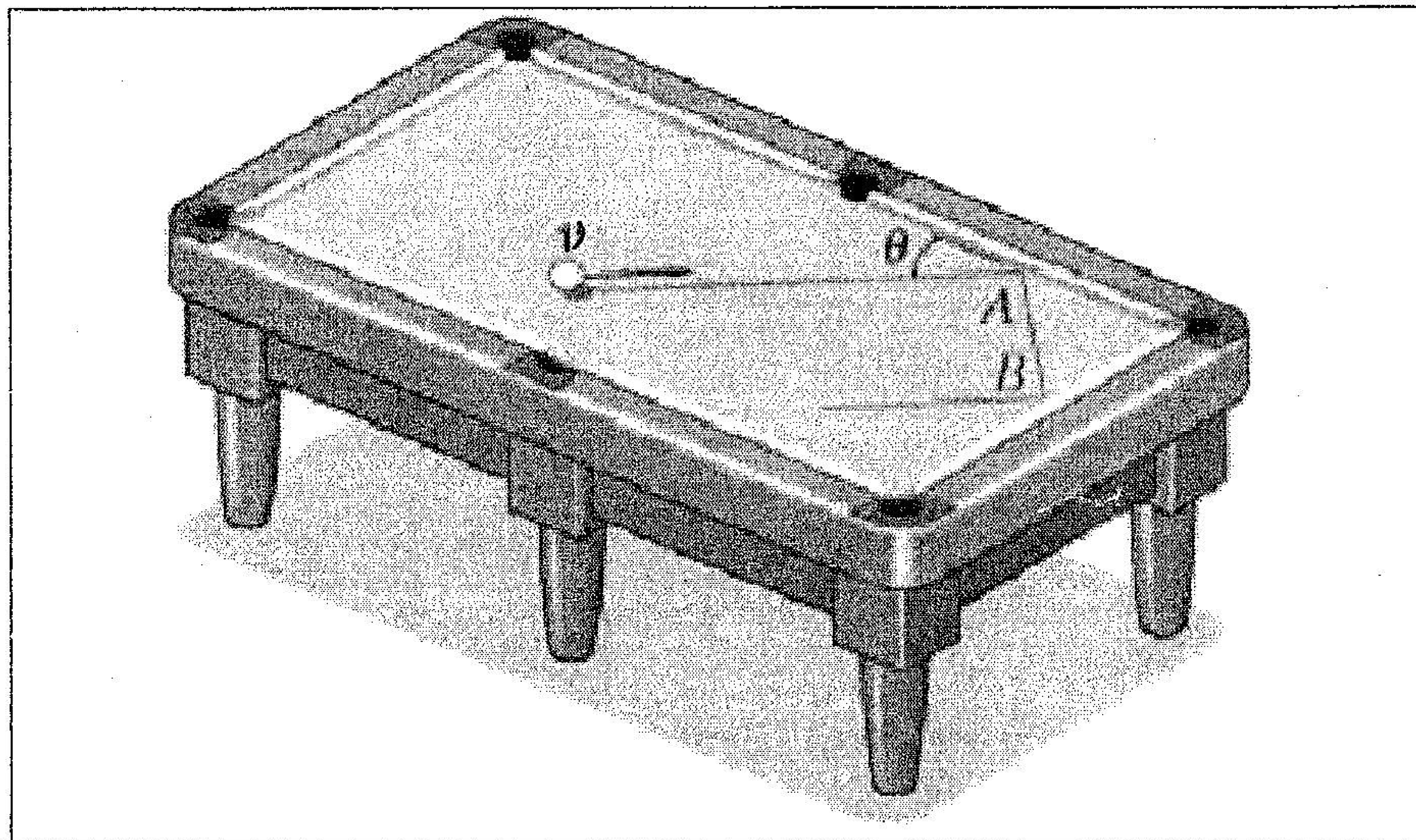
3/20

QB2

The billiard ball of mass M = 200 gm is moving with a speed v = 2.5 m/s when it strikes the side of the pool table at A with an angle, (θ = 45°). If the coefficient of restitution between the ball and the side of the table is e = 0.6, determine

a) the speed and angle of the ball just after striking the table at A **[10 marks]**

b) the speed and angle of the ball just after striking the table at B **[10 marks]**



Solution:

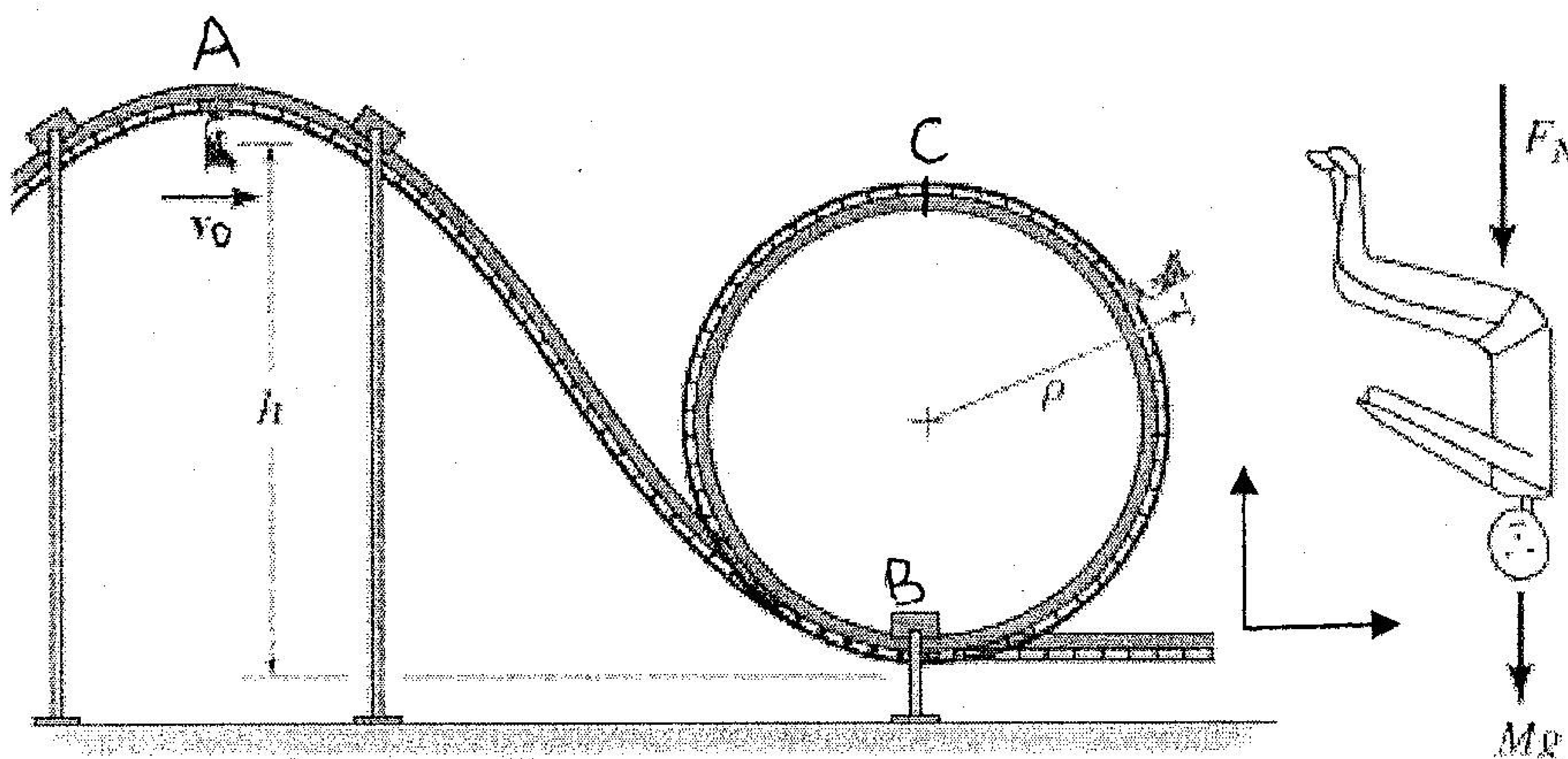
QB3

The Raptor is an outside loop roller coaster in which riders are belted into seats resembling ski-lift chairs. Neglecting friction:

a) Determine the minimum speed (v_0) at which the cars should coast down from the top of the hill, so that passengers can just make the loop without leaving contact with their seats. **[6 marks]**

b) If the cars travel at $v_0 = 4\ m/s$ when they are at the top of the hill (point A), determine their speed when they are at the top of the loop (point C) and the reaction of the passenger of mass $M_p = 70\ kg$ on his seat at this instant. The car has a mass $M_c = 50$ kg, h = 12 m, ρ = 5 m

[14 marks]



F = FN + Mg

Fn = mg = 9.81 * 120

2354.4 = M1v1

2354.4 = 120 v1

v1 = 19.62 m/s

Solution

M1 v1 + ΣFΔt = M2v2

Mg = M v²/r

g = v²/r

9.81 =

(a) v = √(2gh) = √(2×9.81×12) = 15.34 m/s

V = ½ M v0² + √(2gh)

= ½ * (70+50) v² + √(2×9.81×12)

60v² + 15.3 = 0

⇒ 60v² = 15.3 ⇒ v² = 0.255 ⇒ v = 0.5 m/s

5/20

(a) ΣFΔt = M2v2

v0 = 2/g

(b) M1v1 + M2v2 = M1v1' + M2v2' + v²/(gρ)

v1(M1+M2) = v1'(M1+M2) + v0²/(gρ)

4(120) = v1'(M1+M2) + 16/5

480 = v1'(M1+M2) + (16/5)

v1' = 3.9 m/s 476.8 = 120 v1'

v1' = 3.9 m/s

v² + 600 v − 2400 = 0

(b) M1v1 + M2v2 = M1v1' + M2v2'

(M1+M2) v1 = (M1+M2) v' + v²/ρ

= 480 = 120 v' + v'²/5

= −2400 + 600 v' + v'²